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Colorado Green Schools

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Introduction

According to the U.S. Green Building Council (USGBC), Chipeda Elementary in Colorado's Mesa Valley School District 51 is not simply a green school; it is in fact a green model for other schools.

The USGBC promotes Chipeda as a "case study" of what green schools can achieve in a range of areas, including reduction of environmental impact and lower energy use.[1] The case study notes the school is more energy efficient and uses less water than other, comparable schools. Utility data, however, tells a different story. A look at the numbers shows the school actually uses *more* energy than do its peers.

At the end of the 2011-12 school year, Chipeda Elementary spent 87 cents per square foot for electricity in the building, 9 percent more than the average elementary school in the district. It also spent 27 percent more per square foot on gas. Overall, the school used about 7 percent more energy per square foot than the average elementary school. In fact, the school used more energy per square foot than schools that are more than 20 years old.

Chipeda Elementary is not unique. Across Colorado and the United States, so-called "green" buildings often use more energy than their non-green counterparts in the same school districts.

Chipeda Elementary is not unique. Across Colorado and the United States, so-called "green" buildings often use more energy than their non-green counterparts in the same school districts. For example:

- In Spokane, Washington, none of the new green elementary schools are as energy efficient as the traditionally built Browne Elementary School. One of the alleged green schools uses 30 percent more energy than Browne.
- In Santa Fe, New Mexico, the facilities director reports the district will not build another green-certified building anytime soon after the first such facility, Amy Biehl Community School, consistently incurred some of the highest energy costs in the district.[2]
- *USA Today* found that green schools perform poorly in Houston as well. The newspaper reported, "Thompson Elementary ranked 205th out of 239 Houston schools in a report last year for the district that showed each school's energy cost per student. [Green school] Walnut Bend Elementary ranked 155th."[3]

The situation is similar in Colorado, where a number of schools intended to save energy actually use more energy per square foot than other schools.

Of course, not every green school performs poorly. Some green schools are more efficient than their counterparts in the same district. Even when that is the case, however, green schools are often more expensive to build and operate than traditionally built schools, making it questionable whether they save money for the local school district. While that modernization might be a good idea for a variety of other reasons, with improved amenities for students and teachers alike, "greening schools" might not always be the best approach.

Schools provide a good opportunity to assess green building standards in general because they typically have a number of similar buildings nearby for comparison—buildings that are about the same size, have the same basic elements, and are located in the same climate.

This report examines green schools in three Colorado school districts—Aurora, Mesa Valley, Poudre, and Denver—to compare their energy performance with other schools in the same district. Schools provide a good opportunity to assess green building standards in general because they typically have a number of similar buildings nearby for comparison—buildings that are about the same size, have the same basic elements, and are located in the same climate.

Do Green Schools Live up to Their Promises?

Advocates claim many supposed environmental benefits come from green schools. The Colorado chapter of the USGBC defines a green school as "a

school building or facility that creates a healthy environment that is conducive to learning while saving energy, resources and money."[4] Many of the definition's points reflect vague, subjective judgments that are difficult to measure. Efforts to link the health benefits from buildings and the learning progress of students are vague and subject to many other influences.[5]

Energy use and energy costs, however, are useful and objective metrics that can be easily measured and compared. Since a reduction in energy use lies at the center of what it means for a building to be "green," it is the most useful way to compare actual environmental results to traditionally built schools.

Further, the focus of the comparison is on recently built schools. The question is not whether new green schools are superior to old, traditionally built schools. The important question is whether spending more for a new, green school will yield cost and energy savings compared to a new, traditionally built school. Stated another way: Does the energy use of green buildings justify their significantly higher construction and operating costs?

Every school district has at least one green school that uses more energy per square foot than its traditionally built schools.

Using this metric, Colorado's green schools fare poorly. Every school district has at least one green school that uses more energy per square foot than its traditionally built schools. In some cases, the green schools use 60 percent more energy per square foot than the best-performing traditional school in the same district.

At a time when resources for education and for environmental protection are scarce, state legislators and policymakers should look closely at green schools and question whether policies that promote or require those standards actually yield the promised benefits.

What are Green Buildings?

Before examining the performance of green schools in Colorado, it is important to have a clear understanding of the term. Although definitions vary, the most common standard for green schools can be found in the Leadership in Energy and Environmental Design (LEED) system created and promoted by the USGBC.

To meet the LEED standard, building designers must achieve points in a number of categories. The LEED checklist for schools[6] includes the following categories:

- Sustainable Sites
- Water Efficiency
- Energy and Atmosphere
- Materials and Resources
- Indoor Environmental Quality
- Innovation and Design Process
- Regional Priority Credits

Points are awarded in each category. If a school design receives 40 out of a possible 110 credits, it is certified as green. At 50 points, a building achieves LEED Silver status; at 60, LEED Gold; and at 80, the highest rating of Platinum. This study covers a variety of certification levels, including some at the lowest end of the scale, like Aurora Hills Middle School, as well as some meeting the LEED Gold standard, like Bethke Elementary in the Poudre School District.

Some rating categories are specifically designed to save energy. Others are unrelated to energy, like the four points awarded for "Public Transportation Access."

Advocates of LEED argue this system of flexibility allows schools to meet the standard at a relatively low cost. As districts move up the ladder of certification toward Platinum, the flexibility is reduced and the cost can increase significantly.

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Aurora School District

The Aurora Public School District[7] contains three green schools – a middle school, a

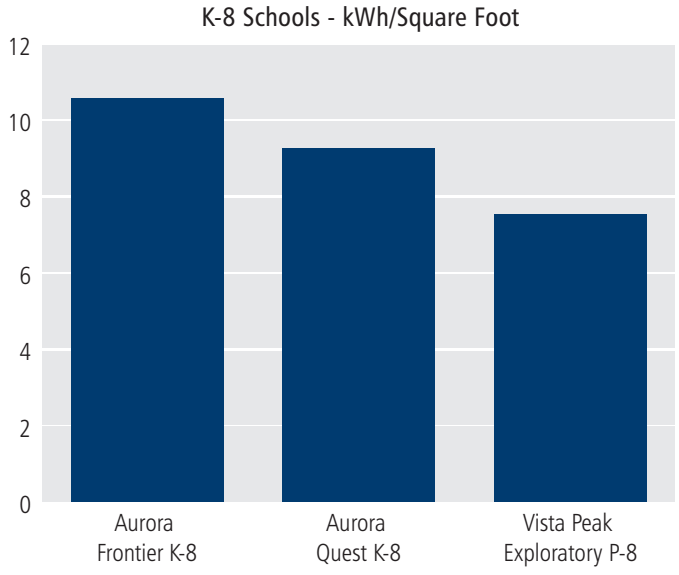
P-8 school, and a high school. In total, the district has 31 elementary schools, three K-8 schools, seven middle schools, and six high schools. To ensure apples-to-apples comparisons, green schools are measured against the performance of other schools of similar size and type in the same district.

Vista Peak Exploratory P-8

During the 2011-12 school year, green-designed Vista Peak Exploratory used 7.53 kWh per square foot— the best energy-saving performance of Aurora's three K-8 schools, a limited basis for comparison. Vista Peak, however, uses about 20 percent less energy per square foot than its two traditionally-built counterparts.

It is important to note that this savings does not guarantee any additional money spent to build the school to green standards will pay off. Such an analysis is virtually impossible since few districts analyze the additional costs to build to green standards.

For the building to pay off in a typical 10-year time frame, however, the district would have had to spend only about $141,000 to bring it up to green standards.



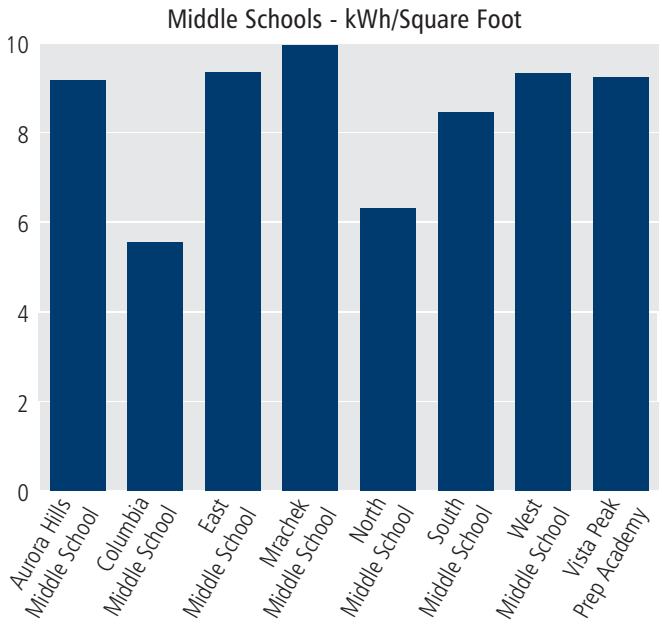
Vista Peak used 787,000 kWh of energy in the 2011-12 school year. Assuming the school would have used 20 percent more energy without the green standards, it would have had to pay for an additional 157,000 kWh of electricity. Using the Energy Information Administration's average electricity cost for Colorado, about 9.15 cents per kWh,[8] the raw savings amount to $14,410 in extra cost. Over 10 years, the savings would total about $144,100.

It would take 23 years to break even without discounting future savings. School buildings typically have a lifespan of about 20 years before they are rebuilt or significantly remodeled.

Typically, green schools cost at least 2 percent more to build.[9] A $16.5 million construction cost,[10] would put the additional cost to achieve green certification at $330,000. The school's energy savings fall far short of breaking even over 10 years. It would take 23 years to break even without discounting future savings. School buildings typically have a lifespan of about 20 years before they are rebuilt or significantly remodeled.

Thus, even using 20 percent less energy per square foot than comparable buildings, Vista Peak Exploratory likely will never justify the cost of building it to green standards.

Figure 1. Comparison of Energy Performance, Selected Aurora Schools



Aurora Hills Middle School

The story is different for Aurora Hills Middle School, which ranks fourth out of eight middle schools in the district. It uses 9.15 kWh of energy per square foot, putting it well above the average of 8.29 kWh per square foot. The best performing district middle school is Columbia, built in 1982, which uses 5.54 kWh per square foot, or about 40 percent less than the green school uses.

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Green school advocates offer a number of reasons to explain why these buildings fail to deliver on promised energy savings. While these reasons are discussed in detail below, one is worth mentioning here. New buildings—both green and traditional—often have more amenities, including air-conditioning, and more outlets to accommodate computers and other equipment. Green school advocates, then, claim that new schools are more comfortable and accommodating. For this reason, they might argue, comparing a school built in 1982 to one built today is inappropriate.

There are a couple problems with these justifications.

First, in the case of Aurora Hills, three of the other seven schools use less energy, so any justification may account for some, but not all, of the discrepancy.

Second, labeling the schools as green implies they are more energy efficient and have a smaller environmental impact than other schools. Arguments that attempt to explain away additional impact on the environment by citing added amenities demonstrates that the adjective "green" is less important than other design goals, like building comfort. It is hard to continue to call these green buildings when the designer has sacrificed a reduction of environmental impact in favor of other priorities.

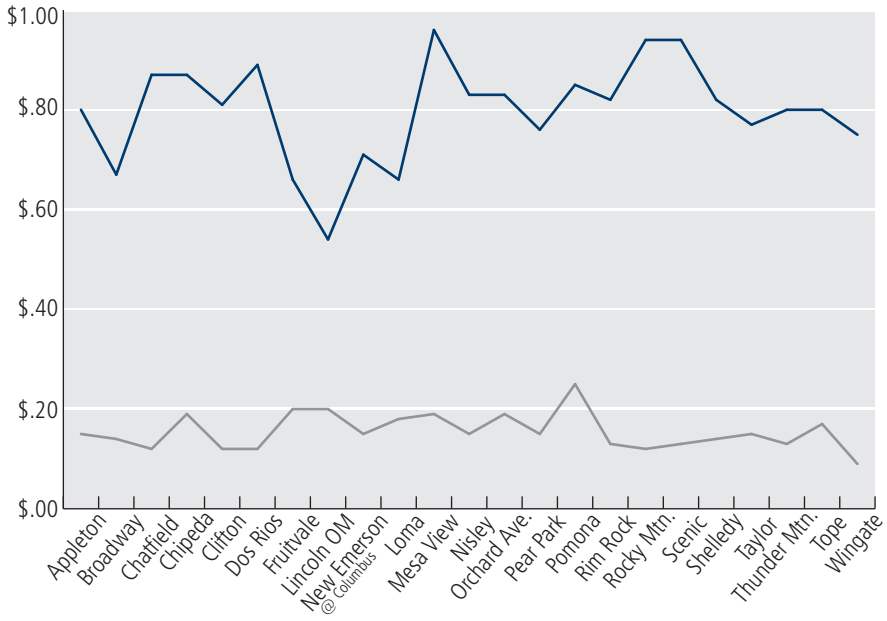
Overall, Aurora's costly green schools offer mixed results. One school performs well while the other does poorly compared to its counterparts. Given that mixed outcome, it is likely that spending additional school funds to meet the green standards would not be a beneficial public expense.

Mesa Valley

Located in western Colorado, the Mesa Valley School District's one and only green school provides a good basis for sound comparisons with the district's 22 other elementary schools.

"Green" Chipeda Elementary School was built in 2008 at a cost of $9.2 million, representing one of the U.S. Green Building Council's top examples for Colorado. In 2011-12, however, this so-called green school used significantly more energy and natural gas than its traditionally built counterparts.

Figure 2. Comparison of Energy Performance, Mesa Valley Elementary Schools



Chipeda spent 87 cents per square foot on electricity, compared to the district average of 80 cents. For natural gas, Mesa Valley 51 spent 19 cents per square foot at Chipeda, compared to a district average of only 15 cents per square foot at the other elementary schools. The numbers show Chipeda as the sixth-worst of 23 schools for electricity use and fourth-worst for natural gas use. In total, Chipeda spends 11 percent more money for

gas and electric than the other elementary schools.

Chipeda spends about 13 cents per kWh for electricity and about 68 cents per therm for natural gas. Compared to the average, the green school spends an additional $34,767 on the two utilities. Compared to the best performing building, Lincoln Elementary—a non-LEED school upgraded in 1991—Chipeda spends $104,302 more on electricity every year, but spends $3,161 less on natural gas, for net spending of $101,141 more than the efficiency of non-green Lincoln Elementary.

Chipeda was built 17 years after Lincoln Elementary and is likely to have a number of additional amenities. Newer buildings often have greater electrical capacity to accommodate computers and other modern electronics. It may also have improved air conditioning. It is up to the people of the Mesa Valley School District to decide whether those additional amenities are worth $100,000 per year in additional costs.

By way of comparison, Rim Rock Elementary was built around the same time as Chipeda but without trying to meet the green standards. Although it is not a green school, Rim Rock spends 6 percent less on electricity per square foot and 32 percent less on natural gas per square foot than Chipeda. For a green school to perform worse than a non-green school built just two years earlier indicates a failure of the standards to produce energy savings. Calling Chipeda a green school is questionable, given its poor record of electricity and natural gas use.

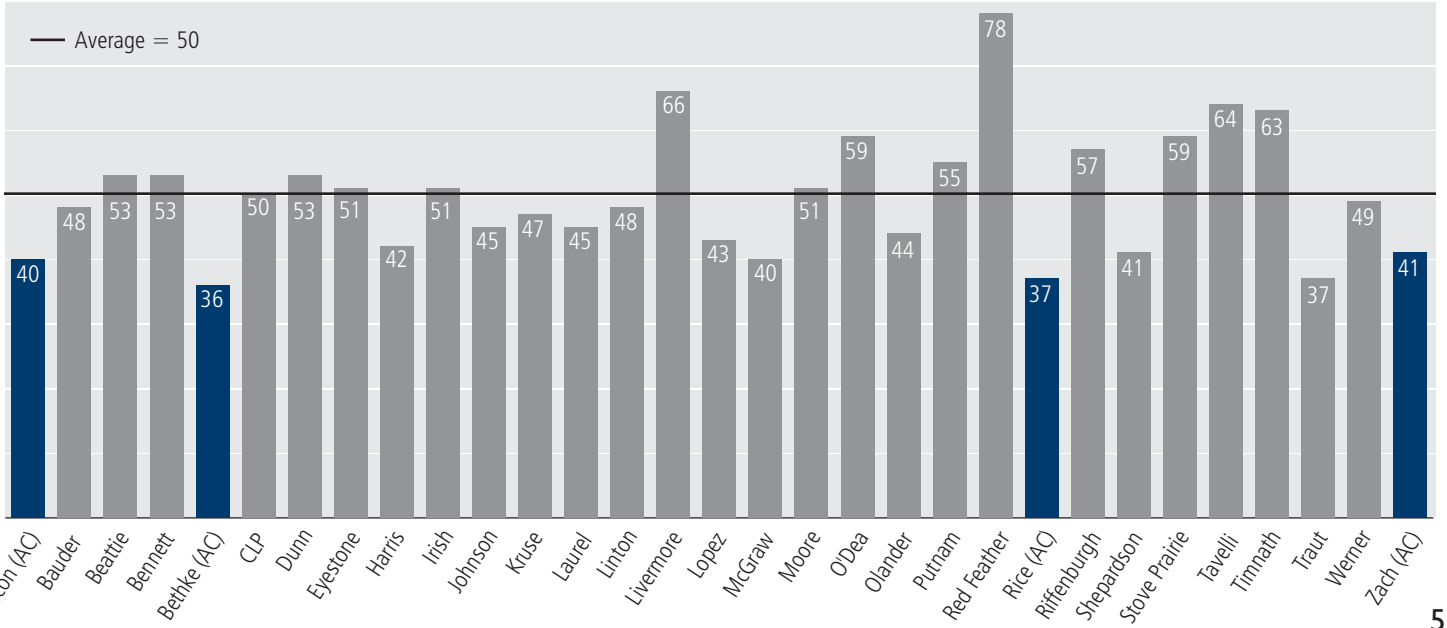
Poudre School District

Few school district administrators assess the performance of their schools after paying more to build them to green standards. An exception is Poudre School District, located in Fort Collins, which has produced reports comparing the energy use for each school building, assessing their efficiency. The district produced a chart comparing the average energy use, electricity and natural gas, for each elementary school in the district.

Figure 3 compares schools based on energy use per square foot during the 2011-12 school year. The blue-highlighted schools have air conditioning. Schools in the district vary widely in age, with some that date back to the late 1800s. While many schools have been remodeled over the years, for some the core building structure was nearly 50 years old in 2012.

The Poudre School District has four certified "green" elementary schools: Bacon, Bethke, Rice, and Zach. To create a suitable comparison of the performance of the four new, green schools, a subset of seven traditionally built Poudre elementary schools were selected: Harris, Kruse, Laurel, McGraw, Olander, Shepardson, and Traut. Five of the seven schools

Figure 3. Comparison of Energy Performance, Poudre Elementary Schools



were built in the last two decades. One of the seven was built in 1978, but is the most recently remodeled (2008) traditional school in the area. The other school, Harris, was built in 1919, but was extensively modernized in 2002.

Taken as an average, the new green schools are more efficient than the comparison set. The four green schools use an average of 38.5 kBTUs per square foot. The schools range from 36 kBTU to 41 kBTU, a difference of about 12 percent between the best and worst performing green school.

The traditionally built schools, by comparison, have an average energy use of 42.3 kBTU—7.5 percent more energy on average. Individually, some of the traditionally built schools actually use less energy than some of the green schools. McGraw and Traut both perform as well or better than two of the green schools.

None of the traditionally built schools have air conditioning, and none of the green schools are without it. As a result, comparing the two groups does not provide a perfect apples-to-apples comparison.

One comfort advantage in the green schools' favor is that they all provide air conditioning. It is impossible, however, to say how much difference this amenity makes in energy use. None of the traditionally built schools have air conditioning, and none of the green schools are without it. As a result, comparing the two groups does not provide a perfect apples-to-apples comparison.

It is clear, nonetheless, that the green schools do not perform as efficiently as promised. For example, Bethke Elementary was claimed to include "improved energy efficiency designs which reduce operating costs 40-50 percent."[11] Bethke uses 36 kBTU per square foot, about 15 percent more efficient than the average of recently built traditional schools, and only about one-third of the energy improvement that designers promised.

Even if the promised energy savings are not achieved, spending more to make a building more efficient may still pay off if energy costs are significant.

For example, the best performing green school, Bethke, spent $29,442 on electricity and $7,682 on natural gas for a total of $37,123.[12] Assuming the costs are 15 percent below what they would be without meeting green building standards, Bethke saves $5,569 annually.

The total construction cost for Bethke was $9.9 million. An extra cost of 2 percent would mean the district spent $198,000 to meet the LEED standards.[13] The most efficient green school in the district, therefore, would have to operate for 35 years before energy savings begin to pay for the higher cost of green construction.

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The calculations do not discount savings over time, nor do they take increased future energy costs into account. If energy costs rise more quickly than inflation, it may take less than 35 years to recover the initial higher cost. If, however, general inflation and the time value of money grows more quickly than energy costs, the time to recover the initial higher cost will be more than 35 years. In either case, however, it is unlikely Bethke's higher green building cost will pay for itself anytime soon. It is more likely the building will be demolished, or extensively remodeled, before building to the costly green standard proves worthwhile.

The same is true for the other schools. The time needed to cover each of the other green schools' higher construction costs is as follows:

- Bacon: 29.5 years
- Rice: 32.7 years
- Zach: 25 years

Even in Poudre, where the performance of green schools is generally better than their peers, real energy savings are difficult to accrue and do not come close to providing a reasonable justification for higher initial costs. If it only cost 1 percent more to meet the green building standards (about half the typical cost), the earliest the district could expect to recover the higher construction cost is from Zach Elementary at 12.5 years.

Poudre School District has achieved better results with its green building program, in part because

officials measure and report real energy use results—an unusual practice in the public sector. The district analyzes energy use per square foot, creates annual reports showing outcomes, and even provides all energy data on the Internet. This remarkable level of transparency is rare among school districts and worthy of praise.

Ultimately, however, the use of green building standards does not yield the promised energy savings, nor is the district likely to recover the additional costs to meet those standards.

Ultimately, however, the use of green building standards does not yield the promised energy savings, nor is the district likely to recover the additional costs to meet those standards. Poudre shows the problem lies primarily with the standards themselves, rather than with district officials. Even a conscientious administration with a sharp eye on measuring success finds it difficult to make the LEED standards work as promised.

Denver

Denver Public Schools is Colorado's largest school district. A wide variety exists among its more than 100 schools, with some sharing a campus, and others that are suited to a particular curriculum. The challenge is to find a representative group of schools to compare.

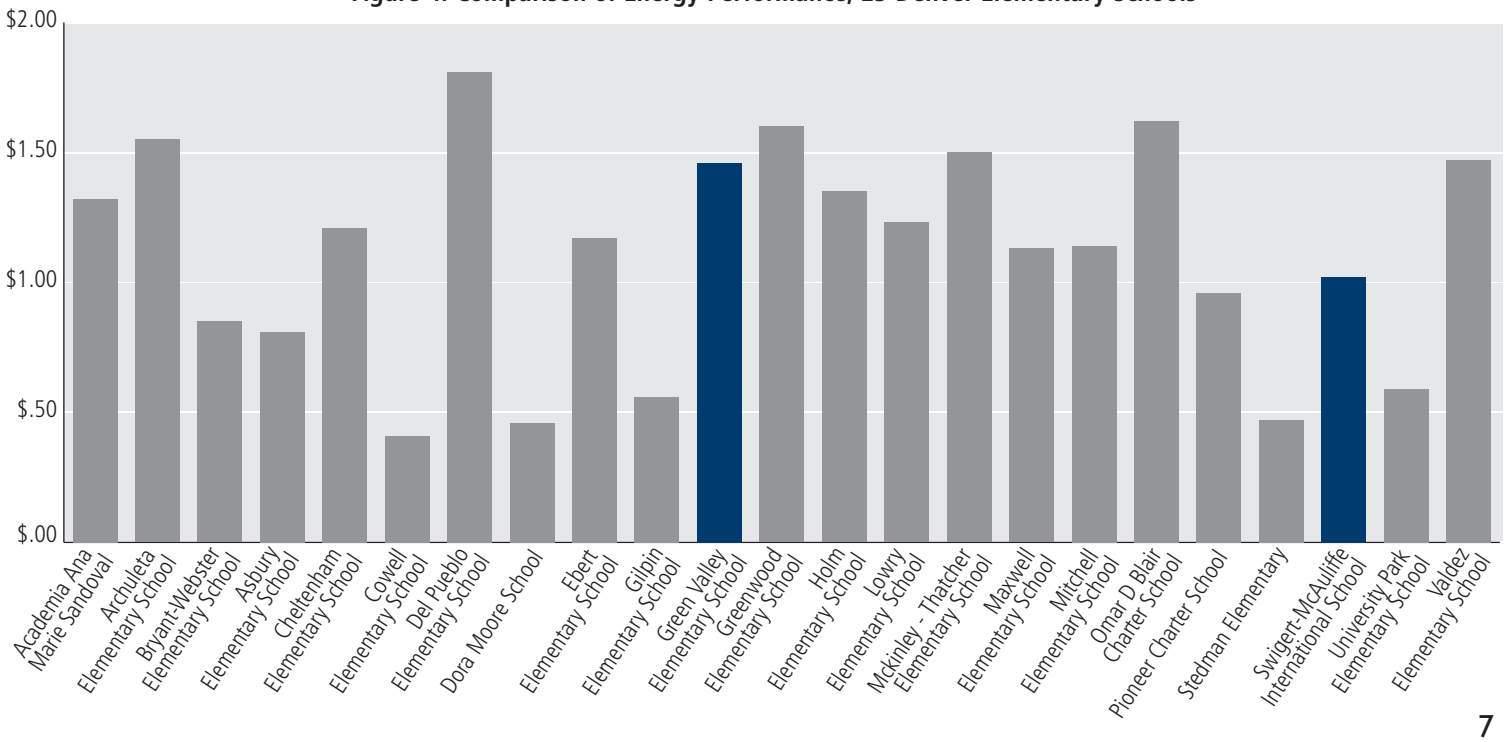
The best option in Denver is to examine the 23 elementary schools between 40,000 and 100,000 square feet, two of which are green schools (Green Valley and Swigert-McAuliffe). The 2011-12 school year analysis does not include the "Denver Green School," which was not open for the full year.

As in Poudre, comparisons combine the total cost for gas and electricity. Ultimately, these utilities are what districts care about in their effort to improve energy efficiency: lower total costs. It also allows comparison among schools that use differing levels of gas and electric for each building.

The results show the green schools do not stand out as particularly efficient. In fact, the two green schools in this group spend an average of $1.24 per square foot on energy, compared to $1.11 for the other schools.

Some adjustment is necessary to understand the numbers depicted in Figure 4. Frequently, the schools with the lowest energy usage also have poor air conditioning systems. For example, the school with the lowest energy use per square foot, Cowell Elementary School, was built in 1954. Another low-cost school, Gilpin Elementary, was built in 1951. Therefore, part of the energy savings is due to climate systems considered sub-standard today.

Figure 4. Comparison of Energy Performance, 23 Denver Elementary Schools



That, however, is not the case with all comparable buildings.

Lowry Elementary School, built in 2002 without meeting green building standards, is more efficient than Green Valley Elementary but less efficient than Swigert-McAuliffe. Based on 2011-12 energy use, Green Valley would have saved more than $16,000 on their energy costs to be as efficient as Lowry. Swigert-McAuliffe, on the other hand, would have spent $21,000 more than it did.

Over the typical 20-year lifespan of a building, Swigert-McAuliffe will save an estimated $420,000 when compared to the efficiency achieved by Lowry Elementary without the green building standards. This represents a small amount of savings over the life of the facility. For example, if the school cost $20 million to build, a 2 percent premium would wipe out the entire savings. The result would be that Denver Public Schools spent a dollar today to save a dollar 20 years from now.

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Green Valley Elementary is less efficient than Lowry, so it actually projects to spend an additional $328,000 over the lifespan of the building. This amount is in addition to any premium paid to achieve green building status.

As noted above, Denver Public Schools can argue that these schools offer other amenities that make the extra cost appropriate. Clearly, though, meeting the standards is a tradeoff that does not guarantee energy efficiency. It may not be appropriate to expect the new buildings to use as little energy as the much older buildings in the district. But when examined next to newer, comparable buildings, the green schools prove to be less than exemplary when it comes to environmental results and energy efficiency.

Why Green Schools Fail

It seems strange that so many schools designed to save energy actually end up using more energy than other schools, and save so little energy that the additional building cost is never recovered. Many analysts wonder why this result is so consistent among schools using the LEED building standard or other green building systems.

The primary problem is that school district officials and green building designers often ignore tradeoffs by sacrificing energy savings for other desired amenities like natural lighting, air conditioning, fresh air, and other benefits. They may be nice amenities, but usually require more energy. Thus they undermine the green label officials are trying to achieve, making it less meaningful or even counterproductive.

There are a few examples.

First, green building systems often promote the use of large windows as a way to provide natural light and reduce lighting costs. Some school designers argue that natural light leads to higher student test scores.[14] Large areas of glass, however, are poor insulators. Whatever gains are achieved in reducing electricity use for lighting are lost with greater energy use to maintain a comfortable room temperature.

Second, designers claim green schools are healthier because they circulate air more frequently, reducing the risk of a "sick building" affecting its inhabitants. Constantly drawing fresh air into the building and adjusting its temperature to comfortable levels, however, significantly increases energy use.

Finally, unless electricity costs are very high, it is difficult to save enough electricity to recover the additional cost of constructing a school to meet the costly LEED rules. Electricity prices may increase in the future, improving the rate of return on the up-front construction costs, but that is speculative. It would be wiser to simply add more wall insulation or to wait and take other steps when electricity costs do actually increase. Spending now in the hope of perhaps saving later is a risky strategy at a time when public resources are limited.

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Reviewing the Record of Green Schools in Colorado

Of the three districts chosen as part of this study, none have green schools that help protect the environment as was promised. Further, none of the schools will come close to recovering their higher initial construction cost, and some schools are less efficient than their non-green counterparts in the same district.

Energy use results vary widely. Some green schools use 20 percent less energy than other schools in the district, while others use 10 percent more energy per square foot than the average school.

Even the best performing schools, however, have cost-recovery periods of more than 20 years. As a result, it is unlikely school officials will ever recover the additional cost that designers incurred to meet the standards in the first place.

Even the best performing schools, however, have cost-recovery periods of more than 20 years. As a result, it is unlikely school officials will ever recover the additional cost that designers incurred to meet the standards in the first place. This observation is true whether buildings were built to the lowest LEED standard or to the LEED Gold standard.

The failure of green buildings to produce energy savings is not unusual, as noted above. The performance of Colorado's green schools, however, provides a further indication that legislators and school officials should think twice before requiring schools to spend additional taxpayer dollars to earn LEED certification. The experience of schools across the country demonstrates that district facilities directors are often adept at finding cost-effective ways to reduce energy use based on the particular buildings they manage. Requiring the directors to meet a formulaic, one-size-fits-all approach, however, often leads in the wrong direction, increasing costs without returning savings.

The failure of green buildings to produce energy savings as promised is also an environmental failure. Many advocates who promote LEED or similar rating systems point to the supposed carbon dioxide emission reductions achieved by green schools. The failure to save energy, or even slow the increase in energy use, wastes resources on efforts that do nothing for the environment. Indeed, misguided green building rules divert funding from efforts that could have a positive environmental impact or fulfill other needs.

Ultimately—for taxpayers, students and the environment—the data shows Colorado's green schools fall well short of their energy-saving promises.

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Endnotes

[1] US Green Building Council, "Green Schools Summit Resources," http://www.usgbccolorado.org/green-buildings/summitresources.html#casestudies (accessed August 8, 2013).

[2] Santa Fe School District, "Santa Fe Pubic Schools Energy Benchmarking Report," October 8, 2012, http://www.sfps.info/DocumentCenter/View/7049 (accessed August 8, 2013).

[3] Thomas Frank, "Green schools: long on promise, short on delivery," *USA Today*, December 11, 2012 http://www.usatoday.com/story/news/nation/2012/12/10/green-schools-construction-leed/1753823/ (accessed August 8, 2013)

[4] U.S. Green Building Council, Colorado Chapter, http://www.usgbccolorado.org/green-buildings/GreenSchoolsColorado.html (accessed August 8, 2013).

[5] For example, test scores vary widely from school to school, and measuring the impact of the school building as opposed to socioeconomic or other factors is virtually impossible.

[6] U.S. Green Building Council, "Schools v2009 Checklist," http://www.usgbc.org/resources/schools-v2009-checklist-xls (accessed August 31, 2013).

[7] Aurora Public School District, http://aurorak12.org/.

[8] Energy Information Administration, "State Electricity Profiles," http://www.eia.gov/electricity/state/ (accessed 8/24/2013).

[9] Washington State Joint Legislative Audit Review Committee, "High Performance Public Buildings: Impact on Energy Use is Mixed," May 18, 2001, http://www.leg.wa.gov/JLARC/AuditAndStudyReports/2011/Documents/HighPerfPublicBuildingsPreliminary.pdf (accessed August 25, 2013).

[10] MKK Consulting Engineers, "Vista PEAK Exploratory P-8," http://www.mkkeng.com/portfolio/vista-peak-exploratory-p-8/ (accessed August 24, 2013).

[11] Schaffer Baucom Engineering & Consulting, "Bethke Elementary School," http://www.sbengr.com/our_work/K-12/K-12.htm (accessed October 12, 2013).

[12] Poudre School District, "School Energy Use Data," http://www.psdschools.org/facility-services/utilities-management/school-energy-use-data (accessed August 25, 2013).

[13] It should be noted that Bethke meets the LEED Gold standard, which typically imposes a cost premium of greater than 2 percent of construction costs. Because it is impossible to determine the actual cost premium paid to build Bethke, however, we have used the 2 percent standard to achieve a conservative estimate.

[14] Districts often claim that green schools yield better test results. The increased natural light is often the source of those claims. The research behind such claims, however, is poor. The analysis of green schools in Washington State using the state's own grading system finds a slight negative, but not significant, correlation between green schools and academic achievement. See Todd Myers, "'Green' Schools Fail to Make the Grade: State Building Rules Do Not Raise Student Test Scores," Washington Policy Center, June 2011, http://www.washingtonpolicy.org/publications/notes/green-schools-fail-make-grade-state-building-rules-do-not-raise-student-test-scor.

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